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## Napierian Logarithm of 5 =

1.6094379	1243410	0374600	7593332	2618763
9525601	3542685	1772191	2640780	8257554
5759268	0738412	2078288	5798574	2982618
5124170	8082338	1773353	3644800	7430601
6314333	5570584	1878072	7874564	5612567
3804931	0408586	1451680	3463508	54+&c.

## Napierian Logarithm of 10 =

2.3025850	9299404	5684017	9914546	8436420
7601101	4886287	7297603	3326304	4104637
8513707	3005047	7285093	1400711	3354530
3350481	2381057	6355463	4093686	9182209
1415335	9829761	8312394	5299109	9105717
7784979	7747709	8399376	1744515	35+&c.

## Modulus of Common System of Logarithms =

4342944	8190325	1827651	1289189	1660508
2294397	0058036	6656611	4454084	2952103
2056138	9388912	2647096	6953461	1420043
3938056	4705613	4312230	2306044	2927744
1521725	4737266	8184290	1672329	4707564
5865061	2932297	5502468	4291564	99+&c.

The foregoing values are, it is presumed, correct to the last figure inclusive.

February 9, 1854.

SIR FREDERICK POLLOCK, M.A., V.P., in the Chair.

A paper was in part read, entitled "Further researches into the properties of the Sulphate of Iodo-Quinine or Herapathite, more especially in regard to its Crystallography, with additional facts concerning its optical relations." By William Bird Herapath, M.D. Communicated by Golding Bird, M.D., F.R.S. Received Jan. 27, 1854.

February 16, 1854.

COLONEL SABINE, R.A., Treas. and V.P., in the Chair.

Joseph Beete Jukes, Esq., was admitted into the Society.

The reading of Dr. Herapath's paper was resumed and concluded.

After referring to the observations of Professors Stokes and Haidinger, as well as to papers already published by himself on this subject in the Philosophical Magazine, the author gives an account of a set of prisms perfectly complementary in their optical characters to those previously described by him, and proves this fact by an elaborate comparison of their various optical relations; from which it appeared, that whilst the  $\alpha$ -prisms (those described in Philosophical Magazine for March 1852) were totally impervious to a beam of polarized light, reflected from glass plates, when the plane of the length of the prism was at right angles to the plane of primitive polarization, the  $\beta$ -prisms (those now examined) were equally ab-

sorbent of a vertically polarized beam, when the plane of their length lay parallel to that of primitive polarization.

These prisms may be readily made by the following process :—

Dissolve 10 grains of disulphate of quinine in half a fluid ounce of spirit of wine, having 3 grains of benzoic acid dissolved in it also ; adding 2 drachms of water and warming the whole to complete solution, then upon adding a few drops of spirituous solution of iodine and placing in repose, prismatic crystals having the following properties are produced :—

1. When two are crossed in superposition at right angles to each other or even at  $30^\circ$ , the overlapped space is "black" if the crystals are sufficiently thick, but reddish brown or violet-red if very thin ; in these respects they perfectly coincide with the  $\alpha$ -prisms.

2. When examined by polarized light reflected from glass, the *vertical* crystals now appear black, whilst the horizontal prisms are almost perfectly transparent to the polarized beam.

3. Upon introducing the selenite stages beneath the prisms, those which previously obstructed the polarized beam and appeared "black," transmitted the "red" or "blue" colours of the selenite films, whilst the transparent, horizontal prisms, exhibited the complementary colours, viz. the green or yellow.

The last two completely decided their complementary character, for whilst the  $\beta$ -prisms were "black," "red" or "blue," when the planes of their length were *vertical*, the  $\alpha$ -prisms were "black," "red" or "blue" whilst the planes of their length were *horizontally* placed.

4. But by mixing the two prisms upon one slide their perfectly complementary character was completely demonstrated, for when an  $\alpha$ -prism was crossed at right angles by a  $\beta$ -prism, the square space where they overlapped was still transparent to common light ; but if a  $\beta$ -prism were overlapped by an  $\alpha$ -prism, the length of the two being parallel to each other, the oblong space where they overlapped became black from their doubly absorbent properties ; in short, the optical examination fully proved the complementary character of these crystals length for length.

It was further shown that two varieties of hexagons existed ; those produced from strong spirituous solutions were longer than broad, and possessed two acute angles of  $65^\circ$  and four equal angles of  $147^\circ 30'$ . Examined by a vertically plane-polarized beam, these were "black" when a line passing through the long diameter or acute angles was parallel to the plane of primitive polarization : these the author called "acute" or  $\beta$ -hexagons. The hexagons produced from acetic acid solutions, on the other hand, were "obtuse" in their character, and had two angles of  $115^\circ$  and four equal angles of  $122^\circ 30'$ . These, when examined by vertically plane-polarized light, were always "black" when a line passing through the two angles of  $115^\circ$  was perpendicular to the plane of primitive polarization : the author called these "obtuse" or  $\alpha$ -hexagons.

The rhombic crystals which presented themselves were also "black" (examined in the same way) when their long diameters lay parallel

to the plane of primitive polarization, but transparent when they were rotated  $90^\circ$ .

It was also shown that the doubly absorbent powers of the primary rhombic crystal extended more or less on each side of the vertical position, through an arc of  $60^\circ$ , so that upon rotating a crystal through the whole circle, there were two arcs of  $120^\circ$ , in which the crystals were more or less darkened, and two of  $60^\circ$ , each in which the light passed through without loss; this transparency was of course at its maximum when the longer diameter of the rhombic plate lay in a horizontal position, and gradually became less evident through an arc of  $30^\circ$  above and below this line. By a careful measurement of the angles of the various crystalline forms and by the results of their optical examination, it appeared that they may all be obtained from the right rhombic prism, the acute angle of which is  $65^\circ$  and the obtuse  $115^\circ$ , the major axis being to the minor as  $1.57$  to  $1$ , whilst the prism itself had scarcely appreciable length. It was a mere rhombic scale; but considered as a short prism, the axes were  $P^a_{0.00001}$ ,  $M^a_{1.57}$ ,  $T^a_{1.0}$ , the quantity for  $P^a$  not being absolutely determinable in consequence of its variability and minuteness.

It appeared also that the  $\alpha$ -prism and obtuse hexagon were the results of truncation of the *acute* angles of the primary rhombic plate or prism by planes at right angles to the plane of primitive polarization, when the crystals were "black," when examined by vertically plane-polarized light; whilst the  $\beta$ -prism and acute hexagon resulted from truncation of the *obtuse* angles of the same primary form by planes parallel to that of primitive polarization, the crystals being "black" when examined by a vertically plane-polarized beam; and that the octagonal and square plates, and rectangular parallelogram resulted from the coincidence of these truncation planes in the same individual form.

It was shown that the solvent medium had the power of developing these truncation planes, and it appeared that *water* produced the  $\alpha$ -truncation, and *spirit* the  $\beta$ -truncation; and if the two opposing forces of water and spirit were made equal in intensity, they neutralized each other, so that the pure primary rhombic prism resulted without truncation.

It was further shown that hyponitric ether developed other crystalline forms, converting the rhombic plate into one of  $75^\circ$  and  $105^\circ$  by truncation planes upon the acute angles of the primary rhombic plate, cutting off portions equal to half the long axis, and leaving the shorter or transverse axis untouched. By this means the new rhombic crystal appeared "black" when the longer diameter was at right angles to the plane of vertically polarized light, as if it had been rotated through  $90^\circ$ , whilst it absorbed the polarized light as before.

As from the examination of certain rectangular quadrilateral prisms of the  $\alpha$  and  $\beta$  varieties, it appeared that Herapathite possesses doubly absorbent powers of nearly, if not perfectly equal intensity, in directions coincident with all three rectangular axes  $P^a$ ,  $M^a$  and  $T^a$ , the author inferred that the development of their optic

axes could not be reasonably expected in these directions. He considered that the biaxial systems of rings would be found to exist in thicker crystals (when discovered), having triangular replacement planes upon the solid angles, either of the shorter or longer oblique diameters of the right rhombic prism, and the results of these optic axes would be seen in a direction perpendicular to these surfaces of replacement.

The various formulae necessary to produce different crystalline forms are given in detail.

The author enters into a re-discussion of the double refractive powers, and attempts to show that Herapathite possesses a principal axis having "positive" characters. He also endeavoured to measure the thickness of certain very thin plates, by the differential tints produced by the exercise of their doubly refracting powers upon the colours of the selenite stages, and found that these thin plates raised the blue of the second order to the yellow and violet; the red of the second to the violet and blue-grey; and the green of the same to orange and violet of the second order. Assuming, therefore, this substance to have similar doubly refracting powers to selenite, and of equal intensity, and also the same index of refraction, their thickness may be estimated as equal to that of a plate of selenite necessary to give the same difference in tint, viz. .000517 of an inch.

These very thin plates no longer possessed the Cantharides-like or brilliant metallic green colour when examined by reflected light. They appeared more like portions of the elytra of the *Blatta germanica*; still reflecting a polarized beam, but of a brown colour, and also retaining their doubly absorbent powers when examined by transmitted light.

The author considers that his recent investigations indicate that whatever properties Professor Stokes may have assigned to the ray reflected from the  $\alpha$ -prisms (which alone were experimented on by him) in the principal plane of the breadth, must be equally true in that reflected from the primary rhombic prism in the principal plane of its length, *i. e.* its long diameter; and whatever properties he may have assigned to the reflected ray from the principal plane of the length of the  $\alpha$ -prism, will be equally true of that reflected from the primary rhombus in the principal plane of the breadth, *i. e.* its short diameter.

The paper concludes with some recently determined facts relating to the chemical characters of this peculiar substance.

Its sp. gr. at 60° Fahr. was found to be 1.895.

It is very sparingly soluble in ether, turpentine or water at the ordinary temperatures, scarcely more than  $\frac{1}{2000}$ th part; boiling water does not dissolve  $\frac{1}{1000}$ th part. It does not appear more soluble in ether or turpentine by boiling. Chloroform does not dissolve it, but has a great attraction of surface for it.

*Alcohol* of .837 dissolves  $\frac{1}{750}$ th part at 57° Fahr., and by boiling, it takes up  $\frac{1}{50}$ th part, which readily crystallizes on cooling in  $\beta$ -hexagons.

*Acetic acid*, sp. gr. 1.042, dissolves  $\frac{1}{750}$ th part at 60° Fahr., and

$\frac{1}{67}$ th part at boiling temperature—iodine volatilizing if the heat is prolonged.

*Diluted sulphuric acid*, sp. gr. 1.0682, does not dissolve it at the ordinary temperatures, but does so readily with the aid of heat. *Sulph. acid*, sp. gr. 1.845, rapidly dissolves it.

*Diluted hydrochloric acid* has but little action on it, but when concentrated, it almost instantly reddens, without dissolving it; upon boiling, it forms a yellow solution, from which minute dark opaque radiating aciculae deposit on cooling.

*Nitric acid* immediately decomposes it even in the cold: upon raising the temperature, iodine at first volatilizes; then nitrous acid vapours are evolved. Iodine is probably partially converted into iodic acid.

*Hydro-sulphuric acid* passed through its alcoholic or acetic acid solution at once decomposes it, converting the iodine into hydriodic acid, with separation of sulphur.

*Alkalies and alkaline earths* in solution at once decompose it, removing the sulphuric acid and leaving a Naples yellow residue containing the quinine and a portion of the iodine; a soluble iodide of quinine is also formed in ammoniacal liquids.